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Printed Page:-4 **Subject Code:- CAS0202**

Roll. No:

NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA
(An Autonomous Institute Affiliated to AKTU, Lucknow)
B.Tech
SEM: II - THEORY EXAMINATION (2025 - 2026)
Subject: Semiconductor Physics & Devices

Time: 3 Hours **Max. Marks: 100**

General Instructions:

IMP: *Verify that you have received the question paper with the correct course, code, branch etc.*

1. *This Question paper comprises of* ***three Sections -A, B, & C.*** *It consists of Multiple Choice Questions (MCQ's) & Subjective type questions.*

2. *Maximum marks for each question are indicated on right -hand side of each question.*

3. *Illustrate your answers with neat sketches wherever necessary.*

4. *Assume suitable data if necessary.*

5. *Preferably, write the answers in sequential order.*

6. *No sheet should be left blank. Any written material after a blank sheet will not be evaluated/checked.*

SECTION-A 20

1. Attempt all parts:-

(1.1) In a PN junction, the depletion region has: (CO1, K2) 1

(a) Free electrons and holes
(b) Only holes
(c) No charge
(d) Fixed ions

(1.2) The advantage of LED is: (CO1, K2) 1

(a) High power loss
(b) High current requirement
(c) Low power consumption
(d) Only emits infrared

(1.3) For an NPN Transistor in normal bias (CO2, K2) 1

(a) only holes cross the collector junction
(b) only majority carriers cross the collector junction
(c) the emitter junction has high resistance
(d) emitter junction is forward biased and collector junction is reverse biased

(1.4) The bias condition for a Transistor to be used as a linear amplifier is called (CO2, K2) 1

(a) forward-reverse
(b) forward-forward
(c) reverse-reverse
(d) collector bias

(1.5) MOSFET is classified as (CO3, K1) 1

(a) Bipolar transistor
(b) Unipolar transistor
(c) Phototransistor
(d) None of the above

(1.6) Gate-Source p-n junction in a JFET is always: (CO3, K1) 1

(a) forward-biased
(b) reverse-biased
(c) unbiased
(d) none of the above

(1.7) The concept of energy quantization was first introduced by (CO4, K1) 1

(a) Einstein
(b) Bohr
(c) Planck
(d) de Broglie

(1.8) How many parameters are needed to specify a pure quantum state on the Bloch sphere? (CO4, K1) 1

(a) 1
(b) 2
(c) 3
(d) 4

(1.9) The phenomena of super conductors was first discovered by _____ (CO5, K1) 1

(a) Kammerlingh Onnes
(b) Neil Bohr
(c) Richard Smalley
(d) Otto lehman

(1.10) Type – I superconductors exhibits (CO5,K1) 1

(a) Single critical magnetic field
(b) Two critical magnetic fields
(c) Many critical magnetic fields
(d) No critical magnetic field

2. Attempt all parts:-

(2.1) What is diffusion current? (CO1,K1) 2

(2.2) State the advantages of voltage divider biasing. (CO2, K2) 2

(2.3) Describe the three main regions of JFET operation. (CO3, K2) 2

(2.4) What is normalization of wave function? (CO4, K2) 2

(2.5) What is the difference between nanoscience and nanotechnology? (CO5, K2) 2

SECTION-B 30

Answer any one of the following:-

(3.1) In a silicon sample, $n=10^{16}cm^{-3}$, $\mu_n=1350cm^2/V\cdot S$, and electric field E=100 6

V/cm. Calculate the electron drift current density. (CO1,K3)

(3.2) A solar cell has an open-circuit voltage of 0.59 volts, a short-circuit current of 2.7 amperes, and a Fill Factor of 0.74. The area of the solar cell is 0.012 m², and the incident solar power is 1000 W/m². Calculate the power conversion efficiency of the solar cell. (CO1,K3) 6

Answer any one of the following:-

(3.3) In a common base connection, I_E = 1mA, I_C = 0.95mA. Calculate the value of I_B. (CO2, K3) 6

(3.4) A Transistor having $\alpha = 0.975$ and I_{CO}= 10 μA is operated in CE mode. What is β for this configuration? If the I_B is 250μA then calculate I_E and I_C? (CO2, K3) 6

Answer any one of the following:-

(3.5) For an n-channel depletion MOSFET: the measured drain current I_D = 4.5 mA when V_{GS} = -2 V. If V_P = -5 V, find I_{DSS}. (CO3, K3) 6

(3.6) A JFET has g_m = 10 mS, I_{DSS} = 10μA . Calculate $V_{GS(off)}$(CO3, K3) 6

Answer any one of the following:-

(3.7) The wave function of a particle is $\psi(x)=Ax$, $0 \leq x \leq 2$ (a) Find the normalization constant. (b) Find the probability of finding the particle between x=1 and x=2 (CO4, K3) 6

(3.8) A particle is in the ground state of a 1D box of length a. The normalized wave function is given by; $\psi(x) = \sqrt{\frac{2}{a}} \cos\left(\frac{\pi x}{a}\right)$.Find the probability of locating the particle between x=0 and x=a/3. (CO4, K3) 6

Answer any one of the following:-

(3.9) The critical field for niobium is 1×10^5 A/m at 8 K and 2×10^5 A/m at 0 K. Calculate the transition temperature of the element. (CO5, K3) 6

(3.10) Penetration depth λ (T) of mercury at 3.5 K is about 750 Å. Find the penetration depth at 0 K. Given T_c for mercury 4.153 K.(CO5, K3) 6

SECTION-C 50

4. Answer any one of the following:-

(4.1) Explain the working principle of an OLED and describe the advantages of OLED technology over traditional LED. (CO1,K2) 10

(4.2) What is band gap? What is the difference between direct and indirect bandgap? (CO1,K2) 10

5. Answer any one of the following:-

(5.1) Describe construction of CE Transistor and the use of a Transistor as an amplifier. (CO2, K3) 10

(5.2) Define Amplification factor. Establish the relation between α, β and γ. (CO2, K3) 10

6. Answer any one of the following:-

(6.1) Describe the drain and transfer characteristic curves of an N-channel enhancement-type MOSFET. Also write the expression for the drain current. (CO3, K3) 10

(6.2) What do you mean by junction field effect transistor (JFET). Explain briefly the 10

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various types and draw the corresponding circuit symbols. Explain the concept of pinch-off voltage with necessary diagram. (CO3, K3)

7. Answer any <u>one</u> of the following:-

(7.1) Compare classical computing and quantum computing in detail. Give important properties of Qubits. (CO4, K3) 10

(7.2) What is Schrodinger wave equation. Derive the independent Schrödinger equation for free particle and discuss its physical significance. (CO4, K3) 10

8. Answer any <u>one</u> of the following:-

(8.1) Describe types, structure, properties and important applications of carbon nanotubes. (CO5, K2) 10

(8.2) State the Meissner effect and mention its significance. Show that superconductors become perfect diamagnetic in an external magnetic field. (CO5, K3) 10